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**TITLE:** Expandable home automation system



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**Abstract Text - ABTX (1):**

A system for and a method of providing an expandable home automation controller is disclosed which supports multiple numbers and multiple different types of data communications with both appliances and subsystems within the home as well as systems external to the home. The system is based upon a central processor, such as a microprocessor-based computer, and is connected by means of a data bus to control the various products and subsystems within a home or commercial building, such as lighting systems, security systems, various sensors, multiple external terminals, as well as to allow for the input of commands by a variety of means such as touchscreens, voice recognition systems, telephones, custom switches or any device capable of providing an input to a computer system. The system functions can be readily controlled by the user utilizing a high resolution graphics display and associated touchscreen interface.

**Brief Summary Text - BSTX (7):**

With the innovative expansion capabilities of the inventive system, simultaneous operation of multiple types of user devices can now be achieved. For example, the home automation system described herein may be connected to simple keyboards, serial data keypads, touchscreens, voice recognition circuitry, hand-held remote controls, computer keyboards or telephones. In fact, virtually any type of electronic subsystem may be connected, by means of an appropriate interface, to the present system.

**Brief Summary Text - BSTX (17):**

A further object of the present invention is to provide an expandable home automation control system in which voice recognition is utilized by the user to instruct the system to control subsystems present in the home.

**Brief Summary Text - BSTX (18):**

A further object of the present invention is to provide an expandable home automation system in which voice recognition may be used in concert with high resolution color graphics displays in order to provide the user with an easy to use interface for instructing the system to perform its control or monitoring functions.

**Brief Summary Text - BSTX (25):**

A further object of the present invention is to provide an expandable home automation control system which utilizes an electronic interface to a multi-zone security system to thereby allow touch or cursor-control of the security system by means of graphics displays.

**Brief Summary Text - BSTX (28):**

The external custom interfaces are connected directly to various external systems, while the external network interfaces are connected directly to multiple external systems. By means of such structure, an 80286-based AT compatible microcomputer can be utilized, by means of the IBM AT data bus, to control various products and subsystems within a home or commercial building, such as lighting systems, security systems, various sensors, multiple external terminals, and to allow for input of commands by a variety of means such as touchscreens, voice recognition, telephones, custom switches or any device capable of providing input to a computer system.

**Brief Summary Text - BSTX (29):**

The method of the present invention is carried out by the use of a Home Environment Automated Real-time Transactor (HEART) which is a standardized, modular, software program that is configured for each installation. Secondary processors are utilized, under HEART control, to relay information to the central 80286-based microcomputer or central processor, or to translate central processor commands into commands their dedicated devices can understand. A star hardware topology is currently utilized. The secondary processors manage the voice recognition and voice synthesis subsystems, telephone communication subsystems, touchscreen subsystems, hand-held remote control unit communications, input/output control and monitoring, security/fire safety and monitoring and other intelligent subsystems such as lighting, audio, video and HVAC.

**Drawing Description Text - DRTX (3):**

FIG. 2 is an schematic block diagram of the security system interface used as part of the apparatus of FIG. 1;

**Drawing Description Text - DRTX (22):**

FIG. 5c is a flow chart showing the voice recognition function of the Polling Loop module of the present invention.

**Detailed Description Text - DETX (9):**

The security system 38 used in the automated environment, may preferably be a Silent Knight Model 4000 security system, available from Silent Knight, of Minneapolis, Minn. Such a home security system 38 is connected to an RS-232-to-security system translator 36 which is in turn connected to the central processor 10 by means of the serial interface 14 and a data bus 12. It can provide simultaneous RS-232 communications with eight separate external systems. When thus configured, the serial interface 14 can communicate directly with any external system, such as an Elographics touchscreen controller, or any other system that uses standard RS-232 protocols. If, as is the case in the preferred embodiment, the external device uses a nonstandard protocol, then an RS-232 protocol converter, such as element 36, can be used to convert between the RS-232 protocol and the protocol utilized by the device to be controlled. That same interface, as is shown as element 14 in FIG. 1, may also be used to connect the central processor 10 and its data bus 12 through a protocol converter 34, if necessary, to various home automation buses such as CEBUS and SMART HOUSE.

**Detailed Description Text - DETX (14):**

Voice recognition circuitry may also be connected by means of the bus 12 to the central processor 10. A speech processor 58, such as, the Model TISPEECH available from Texas Instruments, Dallas, Tex., may be connected to one or more remote microphones 64, such as the Crown PZM microphone, available from Crown International, Inc., of Elkhart, Ind. Such remote microphones provide a means by which the user of the present expandable home automation system can communicate with the system by requesting tasks by voice. The home automation system may provide voice communications to the user by means of one or more remote speaker 66, which in turn are connected to the speech processor 58.

**Detailed Description Text - DETX (30):**

VOICE RECOGNITION CIRCUITRY

**Detailed Description Text - DETX (31):**

The use of voice recognition is an ideal user interface device for a home automation system because it allows the user to control functions in the home simply by speaking. Voice recognition is also useful in certain commercial environments. The use of the high resolution graphics display together with voice recognition allows the present home automation system to provide high quality visual cues to the user of the present control options, feedback of whether the user's command phrase has been recognized and the results produced for the user as the result of a commanded function.

**Detailed Description Text - DETX (32):**

One of the difficulties with the use of voice recognition in home and other environments is that such systems must perform under at least low level background noise and must be able to extract key words or phrases out of a speech or general noise background. The inventive expandable home automation system meets these performance specifications by the use of certain hardware, together with software to enhance the performance of the voice recognition functions in the home environment, as well a high resolution graphics display system.

**Detailed Description Text - DETX (33):**

The implementation of the voice recognition system described herein may be accomplished by means of the central processor 10 and its interconnection along bus 12 to a speech processor 58 which in turn is connected to a remote microphone 64 and a remote speaker 66. The central processor 10 may be, for example, an AT compatible 80286 based microcomputer, Model CAT-902 from Diversified Technology, of Jackson, Miss. and a Model CHI 626B AT-compatible passive backplane system bus, also available from Diversified Technology. As previously discussed, a hard disk storage device is connected to the microcomputer for permanent storage of trained recognition vocabularies. In addition, an extended RAM memory, as previously described, is also provided for connection to the microcomputer to provide rapid loading of new vocabulary data.

**Detailed Description Text - DETX (34):**

The speech processor 58 may preferably be embodied in the present system by one or more Texas Instruments TISPEECH speech processing boards for IBM and compatible personal computers. The system software is available from Texas Instruments as Model TISPEECH, which performs the basic voice recognition, vocabulary loading, and microphone control functions.

**Detailed Description Text - DETX (36):**

In order to effectively utilize the voice recognition system of the present invention, a graphics interface 54, which may be a Model VIP VGA video graphics display generator, available from ATI Technologies, is connected directly to the central processor 10 by means of the bus 12. The graphics display interface 54 is used to drive a video display monitor 56, which may preferably a Mitsubishi AUM-1381A high resolution color graphics display monitor. A separate video graphics display generator and high resolution color graphics display monitor are provided at each voice recognition area in the home, together with a separate microphone and speaker to effectuate control and aural feedback. Also, as described later herein, a

portion of the software which operates the central processor 10 is dedicated to optimizing the voice recognition parameters of the speech processor 58 in order to maximize performance in a home automation or other environment.

**Detailed Description Text - DETX (37):**

Using such a system, the user's voice can be utilized in the present home automation system to provide either immediate or scheduled control of complete living moods, which are comprised of macros of multiple commands, audio/video entertainment system control, such as selection of the desired audio or video source, selection of the source parameters, such as channel selection, play, fast forward, rewind, volume, base, treble, balance control, etc., as well as the audio distribution network, for example, selecting which set of speakers the audio or video system will send its output to, as well as providing a muting function for each of those sets of speakers. In addition, the system can also both control and switch between a plurality of security video cameras, including panning, tilting, zooming of such security cameras. Finally, the voice recognition functions of the present home automation system can be utilized to control a complex home security system 38 having over 32 zones, which is connected to the central processor 10.

**Detailed Description Text - DETX (38):**

When the voice recognition functions of the present home automation system are utilized in concert with the high resolution color graphics display 56, immediate or scheduled control of many home automation features can be accomplished. Such features include direct control of the lighting within the home, or, if preferred, controlling the lighting mood (i.e. choosing from one of a predetermined number of preset lighting levels) either in one room or throughout many rooms of a home. Such a system can select complete living moods, which consists of macros of multiple commands, for various lighting, temperature, open or closed draperies, skylight settings, and entertainment system settings that have been predetermined and stored as data files.

**Detailed Description Text - DETX (39):**

The voice recognition system, in connection with the high resolution color graphic display 56, can also provide home appliance control as well as security system control for components connected to the central processor 10, as has been previously described. In addition, the audio/video entertainment system controls and audio distribution network described above in connection with the use of only a voice recognition system can obviously be controlled with the both the high resolution color graphics display and voice recognition systems.

**Detailed Description Text - DETX (40):**

Additional functions which can be controlled with the combination of voice recognition and high resolution color graphics displays are the security camera switching and control, security camera function and the complex security system 38, as previously described above. Also, local and remote information retrieval, such as time and weather and access to various remote data bases can be achieved using the voice recognition and high resolution color graphics display combination. Control of the locks for various doors of the home as well as bath and spa controls, for example, to run the bath, set the temperature and turn on any pumps or motors, as previously described, can also be achieved by the use of the voice recognition system and high resolution color graphics display system combination. In addition, the telephone system can also be controlled by that combination.

**Detailed Description Text - DETX (42):**

The present home automation system, as has been previously described, by means of its extended bus and ability to interface with a wide variety of devices, can support any user device that can be controlled serially, controlled with a parallel port, or with a custom interface compatible with the standard AT bus used by the inventive home automation system. Since both the bus and number of serial or parallel ports can be increased as desired, the number of interface devices and thus the number of devices in the home environment or commercial environment that can be controlled can also be increased as desired. That allows the disclosed home automation system to be configured to meet the exact needs of each home owner or business user. The system can thus be tailored to the layout of the environment to be controlled. For example, a touchscreen display can be provided in the kitchen, a touch switch with nine buttons can be placed near the exterior doors, voice recognition can be installed in the master bedroom and any inside telephone can be used to control the system.

**Detailed Description Text - DETX (43):**

It should also be remembered that an important aspect of the present invention is the commonality of use between input devices. For example, both the computer keyboard 18 and the voice recognition system use the touchscreen displays for cues and visual feedback. Wall-mounted telephone touch-tone buttons can be used to control a subset of the touchscreen commands. In addition, although not shown specifically in FIG. 1, other user interfaces may be added to the home automation system, such as track balls, mice, joy sticks, light pens and other cursor control devices. In addition, while a hand-held remote control unit is presently used, wireless versions of any of the present interfaces shown in FIG. 1, such as wireless portable

touchscreens and wireless microphones or radios for remote voice recognition, may also be used. Voice recognition may also be used over the telephone when that technology becomes available.

**Detailed Description Text - DETX (44):**

In order to implement the use of multiple types of user devices in a modular manner which allow for different types of devices in different parts of the home to be used to control the home automation system described herein, the following equipment may be simultaneously connected to the home automation system central processor: (1) a standard PC computer keyboard 18; (2) plurality of dry contact switches 28a and 28b may be connected to the central processor 10 by means of a solid state input module and a pull up resistor to a Metrabyte MSSR-32 solid state relay board which is shown as process controller 26b, which is in turn connected to the parallel interface 24b, which may be an MDB-64 parallel controller connected to the AT bus 12 of the central processor 10; (3) multiple Elographics Accutouch touchscreens 16a and 16b connected serially to the central processor 10 by means of the Digicom COM/8 multiport serial interface 14; (4) a plurality of hand-held remote receivers 20 may be serially connected to the central processor 10 by means of the serial interface 14; (5) a telephone system 62 with a plurality of hand sets, or a single line standard telephone system may be connected to the central processor 10 through a telephone interface 60 and the speech processor 58 and the AT bus 12; (6) multiple voice recognition locations may be connected to the central processor 10 through Crown PZM microphones or other remote microphone systems 64 which are in turn connected to respective TISPEECH speech processors 58 running standard voice recognition software which themselves are connected by the AT bus 12 to the central processor 10; and (7) multiple voice response locations with remote speakers 66 which provide spoken information and instructional cues to the user. All of the foregoing equipment is simultaneously connected to the central processor 10 and may be used to perform a plurality of functions.

**Detailed Description Text - DETX (48):**

Functions that can be scheduled in this manner include turning a light or appliance on or off, watering the lawn, turning on different lighting moods at different times of the day, turning on audio music or a television station, VCR recording of television programs, operating modes or features of the home automation system itself, operating modes of a security system, electric locks, reminders for the system user, operating modes of a telephone system and automatic information retrieval. As will be described further herein, the same types of displays may be used directly to control entertainment systems by working with a graphics representation of the entertainment system and its distributed speakers and sources. The user controls the system by selecting his audio or video source from

a graphics display and then selecting the rooms in which he would like the audio and video played.

**Detailed Description Text - DETX (59):**

From the touchscreen shown in FIG. 3g, a security event log function may also be selected, the screen of which is shown in FIG. 31. Also, the air conditioning or heating blowers may be reenabled by the user after they have been automatically shut down by the automation system as the result of a smoke or fire detection by the security system.

**Detailed Description Text - DETX (60):**

FIGS. 3h and 3i show the sub-menu touchscreens which appear when the entry level function is selected from the security management sub-menu touchscreen FIG. 3g. Referring first to FIG. 3h, it can be seen that the screen is dominated by a floor plan schematic of the entry level section of the home. By touching the appropriate secured zone, the user can arm the security system, or disable a particular zone, depending upon the current state of the security system and the selected zone. As shown in FIG. 3h, the user has touched the zone 14 which is the right living room window. The status information at the bottom of the screen, under the zone and name of the zone information, indicates that the zone is currently enabled. The system status information to the left of the floor layout indicates that the system is ready to arm. In a block above the system status information, a zone key is provided.

**Detailed Description Text - DETX (61):**

The sub-menu touchscreen shown in FIG. 3i is similar to the touchscreen shown in FIG. 3h, with the exception that the status of zone 14 is now disabled. Thus, the function box provided on the right hand portion of the screen is one which would allow that zone to be enabled, instead of allowing the zone to be disabled, as shown in FIG. 3h. In the upper left hand corner of the floor layout of FIG. 3i, it can be seen that the user has also disabled another window. Thus, the screen graphically shows the present status of all security zones on the system. In order to arm the security system, the user touches the "ARM SYSTEM" box on FIG. 3i and the touchscreen of FIG. 3j appears.

**Detailed Description Text - DETX (63):**

FIG. 3k shows a sub-menu touchscreen similar to that shown in FIGS. 3i and 3h, except that the status of the security system is now armed. Thus, in the lower left portion of the screen, the status "armed" is shown in place of the "disarmed" status shown in FIGS. 3i

and 3h.

**Detailed Description Text - DETX (71):**

As previously described, this entire sequence can be accompanied by verbal prompts, generated by the voice recognition and speech synthesis circuitry 58, to prompt the user through the scheduling scheme. Many different types of events can be scheduled in this manner, such as a lighting system event, control of the audio/video entertainment system, the energy management system, individual appliances and the configuration of the system itself. Thus, system features and functions can also be scheduled by the user, such as spoken alerts, pass codes, etc.

**Detailed Description Text - DETX (81):**

The foregoing types of information can also be requested with any wired or wireless cursor control or general input device, such as a mouse, touchscreen 16, light pen, joy stick, keyboard 18 or voice recognition system.

**Detailed Description Text - DETX (87):**

INTERFACE TO A MULTI-ZONE SECURITY SYSTEM

**Detailed Description Text - DETX (88):**

Another capability of the present home automation system is its ability to interface to multi-zone security systems and to allow user control of such security systems by means of interactive touchscreens 16 and other alternative control interfaces. The present home automation system is designed to interface to and take advantage of the advanced features offered by sophisticated security systems Thus, the home automation system is designed to operate with an external security system, which provides several advantages.

**Detailed Description Text - DETX (89):**

First, the present system can be performing control tasks while the security system is calling the alarm service. One of those control tasks can be contacting someone else by telephone as a backup to the alarm service. Another advantage of being designed to operate with an external security system is that the present home automation system can monitor the performance of the security system and can keep a separate log of all security events. Still another advantage is in the use and power of the interaction by the user with the security system by means of a high resolution color graphics display and cursor control devices. Such an interaction allows the user interface to be greatly improved and simplified over those previously

known. Further, the home automation system, since it is designed to operate with external security systems, can be utilized with the very latest security systems and can take advantage of improvements and updates to such security systems.

**Detailed Description Text - DETX (90):**

Another advantage of integrating a security system into the present home automation system is the ability to provide information to the user while announcing the alarm. The system can speak the location of the intruder or fire while displaying that location on a floor plan screen of the home. It also turns on all lights in the house to light exit routes and shut down heating system blowers to minimize smoke circulation in the house.

**Detailed Description Text - DETX (91):**

A preferred external security system to which the present home automation system may be interfaced is the Silent Knight 4000 security system, available from Silent Knight. That home security system is shown as element 38 in FIG. 1. It is interfaced to the central processor 10 by means of a custom RS-232-to-security system translator 36, which in turn is connected to the serial interface 34a and then through the AT bus 12 to the central processor 10. The interface or translator 36 is a microprocessor-based translator and controller.

**Detailed Description Text - DETX (92):**

In addition to connecting the home automation system to the security system bus, it listens to and interprets all data instructions generated by the security system on its bus, and translates commands from the home automation system to the security systems' , data protocol so that the security system will receive the commands and respond appropriately. Besides allowing the security system 38 to receive and respond to commands from the central processor 10, which are ultimately generated by the user of the system, the home automation system is also able to record security events on a real time basis.

**Detailed Description Text - DETX (93):**

As shown in FIG. 2, a four wire bus is utilized by the Silent Knight home security system 38, two wires for power and the other two for data transmission. The interface translator 36 connects to all four wires of that bus. Data originating in the security system 38 is first level shifted from a data stream between +12 volts and ground to a data stream between +12 volts and -12 volts and then passed to an input bus of a Z80-based microcomputer. Under control of an EPROM

resident program, the Z80 microprocessor translates data and instructions appearing on the bus. Such data and instructions exit the translator 36 in RS-232 format, from which they ultimately reach the central processor 10. When the home automation system gives a command to the security system, it passes through the Z80 microprocessor, is converted to the proper format and timing for the security bus, passes through another level shifter and is then converted to the +12 and ground format used by the security system 38.

**Detailed Description Text - DETX (98):**

As has been described herein, the present expandable home automation system is a distributed processor system, in which a central processor 10 is integrated with a collection of secondary processors associated with the various interface elements. The disclosed home automation system is preferably arranged with a star topology, in which the secondary processors serve to relay information to the central processor, or to translate commands received from the central processor into commands that their dedicated devices can understand. As has been described, the secondary processors manage the following subsystems: voice recognition and voice synthesis; telephone communication; touchscreen communication; hand-held remote control unit communication; input and output control and monitoring; security and fire system safety and monitoring; and other optional intelligent subsystems, such as lighting, audio and video and HVAC.

**Detailed Description Text - DETX (102):**

A flow chart of the functions performed by the Subsystem Interrupt Handler is shown in FIG. 4b. All of the tasks and devices based on a serial line, such as the touchscreen, hand-held remote control unit and security system, are supported by the interrupt handler, running in the background. When a byte of data is received at any serial port, an interrupt request line is raised, which causes the interrupt handler to execute. The interrupt handler determines which serial port caused the interrupt, copies the new data into that port's queue and then increments that queue's pointer. The Polling Loop, which is shown in FIGS. 5a and 5b, monitors the queue pointer and jumps to the queue's task when the queue pointer moves.

**Detailed Description Text - DETX (116):**

6. Voice recognition board 0

**Detailed Description Text - DETX (117):**

7. Voice recognition board 1 (optional)

**Detailed Description Text - DETX (131):**

FIG. 5c is a flow chart showing the voice recognition portion of the Polling Loop. After it has been determined that a key of the keyboard 524 has not been pressed, a determination is made as to whether the voice recognition circuitry is enabled 554. If that determination is affirmative, then a determination is made as to whether a telephone call is currently active 556. If a telephone call is currently active, then the system skips to the touchscreen 1 queue at step 558.

**Detailed Description Text - DETX (134):**

If the current state is determined to not be the neutral state, then the system checks voice recognition to determine whether a template number has been returned from the currently active voice recognition board 580 at step 578. After steps 570 and 574, if it is determined that a template number has been returned, the program proceeds to again determine whether a template number has been returned at 578. If a template number has been returned, then the recognition score is displayed 582 and the simulated touch coordinates are set to the middle of the screen 584. The system then jumps to the master touchscreen immediate response module 586.

**Detailed Description Text - DETX (135):**

In the event that no template number has been returned at step 578 or if the voice recognition is determined to not have been enabled, the system moves to the touchscreen 1 queue 558.

**Detailed Description Text - DETX (142):**

Task 4: Master touchscreen and voice recognition boards

**Detailed Description Text - DETX (175):**

If, as discussed in connection with FIG. 7c, the main menu state is initialized at 786, the master touchscreen subroutine jumps to the initialization entry point 786 shown on FIG. 7d, which is a flow chart of the general Contextual State of the master touchscreen task or subroutine. After the initialization entry point, the system sends a "prompt" phrase over the speaker 788, such as "enter your selection", or any other phrase preselected by the user and stored as a data file on the system hard drive. The general Contextual State master touchscreen subroutine then loads the main menu screen and indicates the status of the menu options, if necessary 790. The speech recognition vocabulary, if applicable, is then loaded 792 and the system then sets the state to the current Contextual State entry point 794 and returns to the top of the Polling Loop 500.

**Detailed Description Text - DETX (184):**

FIGS. 7g through 7n depict a flow chart for the security floor plan sub-menus for the master touchscreen subroutine. At the initialization entry point 410, the user has selected a security/fire option from the main menu and has selected from the security management menu shown in FIG. 3g one of the three levels shown of the home. The security floor plan sub-menu subroutine then stores the selected floor number, loads the selected floor plan screen data, speaks a responsive phrase through the speaker and voice synthesizing system, such as "Please wait for response form the security system" and then displays a "please wait" message 412. The subroutine then sends a "zone map request" to the security/fire interface shown and described in connection with FIGS. 8a-8c, sets the Security/Fire Task to the "zone map request" state; and inserts a "security response expected" ISIS event into the ISIS queue 414. The Master Touchscreen Task state is then set 416 and the system returns to the top of the Polling Loop 500.

**Detailed Description Text - DETX (187):**

Depending upon the result determined at step 426, the system may go directly to decode the armed or ready conditions of the security system and determine that the security system is armed or ready at step 428. Or, it may reach step 428 either directly or after informing the user of the response received at step 426. For example, if no response was received at step 426, the system speaks the phrase "no response" at 430 and then moves to step 428. If, on the other hand, an "unexpected response" was received at step 426, then the system will inform the user by speaking the phrase "unexpected response" 432, before moving onto step 428.

**Detailed Description Text - DETX (189):**

FIG. 7h shows the entry points for the redisplay security floor plans function 301, the show zones, status 303 and the show security system status 305, in addition to continuing the flow chart from the substate decoder 438. When the redisplay security floor plans 301 is jumped to, the system sets the fade color to black, loads the floor plan screen according to the current floor number and then sets the fade color to normal 307. The show zones, status 303 entry point occurs after step 307. The program then decodes the zones, status 309 and marks the zones on the screen as well as displaying the status of any open or shunted zones 311. After step 311, the system reaches the show security system status point 305. The security floor plan sub-menu routine of the master touchscreen task then shows the armed or ready status on the screen of the monitor 313 and determines whether the user has previously selected a zone 315. If the user had selected a zone at step 315, the selected zone is marked 317 and the print zone status subroutine is called at 319. If no zone is selected at

step 315, the phrase "no zone selected" is printed or displayed on the screen 321.

**Detailed Description Text - DETX (197):**

If the arm/disarm system function box is selected at step 452, the security floor plan sub-menu subroutine branches to the arm/disarm system substate or subroutine 458 and first removes the current "screen time out" ISIS event and sets the touch flag to 0 at 470. A determination is then made as to whether the security system is currently armed 472. If the security system is currently armed, then the arm flag is reset at 474. If the security system is not currently armed, then the arm flag is set at 476. After the arm flag is either set or reset at steps 476 or 474, the voice synthesis system causes the speaker to transmit the phrase "Please enter your security pass code" to prompt the user to input the appropriate security system password so that the system will permit a change from the armed or disarmed state to the other. The user either speaks or in some other manner inputs the password and the subroutine then calls a Get Password subroutine 480 which captures the password. If no password is entered (a "null" password) 482, then the current security floor plan is redisplayed at 466.

**Detailed Description Text - DETX (198):**

If a password is captured by the home automation system, then a determination is made as to whether the arm flag is set 484. If the arm flag is set, then an arm security system message and the password are sent to the Security/Fire Interface. The Security/Fire Task state is then set to the "arm system" state 488 (step 899 in FIG. 8c). If it is determined that the arm flag is not set at step 484, then a disarm security system message and the captured password are sent to the Security/Fire Interface 490 and the Security/Fire Task state is then set to the "disarm system" state 492 (step 870 in FIG. 8c). After the setting of the Security/Fire Task state to either the "arm system" or "disarm system" states at 488 or 492, respectively, the subroutine sets the "Security Response Expected" ISIS event at 494 and informs the user to please wait by speaking that phrase 496 as well as displaying that message on the monitor 498.

**Detailed Description Text - DETX (204):**

If the shunt zone substate is selected at 462, as shown in FIG. 7i, then the program jumps to the shunt zone subroutine shown at point 459 in FIG. 7l. The shunt zone subroutine then removes the "screen time out" ISIS event and says that sets the touch flag to 0 457. A determination is then made as to whether the security system is currently armed at 455. If the determination of that decision is affirmative, then the system speaks the phrase "Please enter your security pass code" 453 so that the user may enter the appropriate

password. The get password subroutine is called in order to capture the password entered by the user and then a determination is made as to whether a null password has been entered 451. If a null password has been entered at point 451, then the appropriate security floor plan is redisplayed 466. If the password entered is a potential password, then the shunt zone command and the password are sent to the security/fire interface 477 and the "security response expected" ISIS event and the zone number for the ISIS event are stored 449.

**Detailed Description Text - DETX (205):**

If, at step 455, a determination is made that the security system is unarmed, a shunt zone message is sent to the security/fire interface 447 and the ISIS event is set to "security response expected" and the zone number for the ISIS event is stored 449. After storing the zone number for the ISIS event, whether the security system is armed or unarmed, the shunt zone subroutine then proceeds to set the Security/Fire Task to the "shunt zone" state 445 and to inform the user to wait by both speaking the phrase "please wait for response form the security system" and by displaying "Please wait" as a message on the monitor screen 443. The appropriate Master Touchscreen Task substate is then set 441 to prevent further user actions until the security communication is resolved, and the program then returns to the Polling Loop 500.

**Detailed Description Text - DETX (210):**

The system then determines whether the security system is ready at 417. If the security system is ready, then a determination is made as to whether the security system was ready before the shunting occurred at 415. If the determination is made that the system was not ready before the shunting occurred, then the phrase "now ready" is spoken and the security floor plans subroutine continues to determine whether the security system is armed 411.

**Detailed Description Text - DETX (211):**

If a determination is made at point 417 that the security system is not ready, then a determination is made as to whether the security system was not ready before the shunting occurred 409. If the outcome of that determination is negative, then the phrase "now not ready" is spoken and the security floor plans subroutine then moves to a determination of whether the security system is armed at 411. In the event that the security system was not ready before shunting at 409 or whether the security system was ready before shunting at 415, the security floor plans subroutine then moves to determine whether the security system is armed at 411.

**Detailed Description Text - DETX (212):**

If the security system is armed at 411, then a determination is made as to whether the security system was already armed before the shunting 405. If that determination is negative, then the phrase "now disarmed" is spoken 403 and the system then determines whether the security system is armed 401.

**Detailed Description Text - DETX (213):**

If the determination at step 411 is that the security system is not armed, then a determination is made as to whether the security system was disarmed before the shunting occurred at 300. If the outcome of that determination is negative, the phrase "now disarmed" is spoken 302 and a determination is again made at 401 as to whether the security system is armed. If the outcome of the determination of whether the security system was disarmed before shunting at 300 is affirmative, the security floor plan subroutine then determines whether the security system is armed at 411. If the security system is armed at 411, then the current security floor plan is redisplayed 304.

**Detailed Description Text - DETX (214):**

If the security system is not armed at point 401, then the "please wait" message displayed on the screen is erased 306, the zone marker is erased and the current highlighted box on the screen is blanked at 308 and the system then displays the security system status at 310.

**Detailed Description Text - DETX (225):**

If the state at step 860 is to determined to be the "disarm system" state, then the program determines what type of command was received at step 870 and branches to the appropriate point. If the command received in the disarm system state is an acknowledgment, then the program sets the result equal to good at step 872 and then jumps to the Master Touchscreen Task disarm security system substate 880. (Step 491 at FIG. 7k) If the command at step 870 determines that the system has already been disarmed, then the result is set to already disarmed at step 874 and the program then jumps to the master touchscreen disarm system substate at step 880. If the command at step 870 is determined to be the rejection of the password inputted by the user, then the result is set to equal password rejected at step 876 and the program then moves to step 880. (Step 491 at FIG. 7k) If the command at step 870 is not one of the three commands already discussed, then the program goes to the Neutral State at step 878.

**Detailed Description Text - DETX (228):**

Lastly, if the Contextual State determination at step 860

indicates that the current state is the arm system state, then a determination is made at step 899 as to which command has been received. If an acknowledge command has been received at step 899, then the result is set to good at step 897 and the program then goes to the master touchscreen task arm/disarm security system substate 895. If the command received at step 899 is the already armed command, then the result is set to equal already armed at step 893 and the program then goes to the Master Touchscreen Task arm/disarm security system substate 895. If the command at step 899 is determined to be not ready, then the result is set equal to not ready at step 891 and the program then proceeds to step 895. If the command at step 899 is determined to be the password rejected command, then the result is set equal to rejected password (a rejected password means the same as "bad password" in FIG. 7k) and the program goes to the Master Touchscreen Task arm/disarm security system substate 895. (Step 491 in FIG. 7k) If the command at step 899 is determined to be any other command than those previously discussed, then the program executes to the Neutral State 878.

**Detailed Description Text - DETX (234):**

If at step 1314 it is determined that the detected security response expected ISIS event is not being executed for the first time, then result is set to equal "no response" at 1320 and, depending upon the current master touchscreen state determination at step 1322, the subroutine jumps to the zone map request entry point (step 424 in FIG. 7g) at 1324, the arm/disarm security system substate entry point (step 491 in FIG. 7k) at 1326 or the shunt zone substate entry point (step 439 in FIG. 7m) at 1328.

**Detailed Description Text - DETX (235):**

FIG. 13c shows the flow chart for the Wait For Bad Password subroutine of the ISIS events. When a "wait for bad password" ISIS event is detected at 1330, the subroutine sets the result to "no bad password message" during delay 1332 and then sets the Security/Fire Task state to Neutral 1334. A determination is then made of the current master touchscreen state 1336. Depending upon the current state, the system either then moves to the arm/disarm security system substate entry point 1326 or to the shunt zone substate entry point 1328.

**Detailed Description Text - DETX (239):**

The following discussion describes the Arm/Disarm Security System algorithm, assuming no errors occur.

**Detailed Description Text - DETX (241):**

The Security/Fire Task sets the result to "good" 872 and then jumps to the arm/disarm security system entry point 872 in FIG. 8b or point 897 in FIG. 8c.

**Detailed Description Text - DETX (243):**

In the event that the password sent was an invalid password, then the Security/Fire Interface will send a "bad password" message, as shown on FIG. 8b at step 876 and FIG. 8c at step 889. If the Security/Fire Task receives a bad password message, then it will set the result equal to "bad password" and jump to the arm/disarm security system entry point at 876 in FIG. 8b or point 889 in FIG. 8c. If the result is a "bad password", then the system is caused to speak the phrase "Security system reports an invalid password. Please try again", at step 475 in FIG. 7k.

**Detailed Description Text - DETX (244):**

Once the "wait for bad password" ISIS event times out at step 1330 in FIG. 13c, the result will be set to "no bad password message during delay" at step 1330, the Security/Fire Interface state will be set to Neutral at step 1334 and the system will then jump to the arm/disarm security system entry point 1326.

**Detailed Description Text - DETX (245):**

Since the result is "no bad password message during delay", a zone map request is sent to the Security/Fire Interface at step 483 in FIG. 7k and the substate is set to prevent touches from initiating any new action, as described earlier in connection with FIG. 7k, step 483. Those steps are performed in order to determine the current armed or ready state of the security system.

**Detailed Description Text - DETX (246):**

The Security/Fire Interface then sends the requested zone. The Security/Fire Task sets the result equal to "zone map returned" and jumps to the arm/disarm security system entry point at FIG. 8c, steps 894 and 898. The zone map is returned prior to step 467 in FIG. 7k.

**Detailed Description Text - DETX (247):**

Depending upon the various combinations of current and previous armed and ready conditions of the security system, the system continues, and, by performing steps 467, 465, 463 and 461, informs the user of any changes.

**Detailed Description Text - DETX (251):**

Since the result is set to "good", a "wait for bad password" ISIS event is inserted at step 487 in FIG. 7m and then the master touchscreen substate is set to show a cursor but not compare user touches with the display boxes, at step 433. The purpose of the "wait for bad password" ISIS event is to allow the Security/Fire Interface time to respond with a "bad password" message in the event that the password sent is invalid, or the security system was armed and no password was sent with the shunt zone command.

**Detailed Description Text - DETX (253):**

If the result is "bad password", then the system speaks "Security system reports an invalid password. Please try again" at step 429 in FIG. 7m.

**Detailed Description Text - DETX (292):**

In order to describe the operation of the disclosed home automation system in normal use, the following describes how the user would utilize the touchscreen to control the security system. It should be understood, however, that controlling the security system is only one of the functions as described herein, but is believed to be representative of how the instant home automation system operates. The following example shows, how, using touchscreen commands, a user would disable a security zone, and then arm his security system.

**Detailed Description Text - DETX (298):**

In this example, the user will disable a single security zone so that a window can be left open, and then arm the security system using a floor plan screen display. To do this, the user touches the menu box labelled ENTRY LEVEL on FIG. 3g, since the zone to be disabled is on that floor. The menu box is highlighted, and when the user lifts his finger, the display changes to show a floor plan of the entry level of the home, FIG. 3h.

**Detailed Description Text - DETX (300):**

In order to disable the right living room window, the user first selects that window by touching it on the floor plan display. The system responds by highlighting the window with a colored box, and describing the associated security zone and its status at the bottom of the screen. To disable the zone, the user then touches the white box labelled disable zone. (See FIG. 7i). The system responds by requesting the home security system to disable the zone and awaits confirmation of its request from the security system. (See FIG. 7l).

**Detailed Description Text - DETX (302):**

The next step in this example is for the user to arm the security system. To do that, the user touches the white box labelled ARM SYSTEM. (See FIG. 7i). The box is highlighted, and the display changes to a pass code display as shown in FIG. 3n. (The flow chart of FIG. 7j calls another Contextual State, which is shown in FIG. 7d).

**Detailed Description Text - DETX (303):**

The next step is for the user to enter a security password code, one digit at a time, followed by the command OK. If the code is correct, the system sends an "arm" request to the security system, as shown in FIG. 3j. When confirmation is received, the Entry Level screen is again displayed with the green "ready to arm" indicator replaced by a red "armed" indicator as shown in FIG. 3m.

**Detailed Description Paragraph Table - DETL (1):**

TABLE 1 _____ Example of a Specific Task Description - Task 1: the Fire/Security Interface _____ Data Validation: The data validation consists of the following states: 1st Synch byte: Must be equal to 52 or data is rejected 2nd Synch byte: Must be equal to 126 or transmission is rejected Length byte: Receive length of message Command byte: Receive command byte Data bytes: Receive appropriate number of data bytes, if any Checksum byte: Must be equal to sum of all bytes in message MOD 256 or transmission is rejected Immediate Response: Call security device driver to send acknowledgment of receipt of message. Neutral State: If command is Fire Alarm, then set Master Touchscreen task to Fire Alarm State, jump to Fire Alarm State in Master Touchscreen Task. end if If command is Security Alarm, then set Master Touchscreen task to Security Intrusion State, jump to Security Intrusion State in Master Touchscreen Task end if If command is any other type of alarm, then call lighting moods device driver to turn on all lights end if ignore all other commands return to Polling Loop Contextual States: Waiting for response to disarm system request: if command is acknowledgment then result = good jump to Disarm Security System substate of Master Touchscreen Task else if command is system already disarmed result = already disarmed jump to Disarm Security System substate of Master Touchscreen Task else if command is password rejected result = password rejected jump to Disarm Security System substate of Master Touchscreen Task else execute Neutral State without changing Contextual State end if Waiting for a response to shunt zone command: if command is acknowledgment then result = good jump to Shunt Zone substate of Master Touchscreen Task else if command is rejected password then result = rejected password jump to Shunt Zone substate of Master Touchscreen Task else execute Neutral State without changing Contextual State end if Waiting for interface to return zone map if command is zone map then result = good jump to substate that

requested a zone map else if command is rejected password result = rejected password jump to substate that requested a zone map else execute Neutral State without changing Contextual State end if Waiting for response to arm system request: if command is acknowledgment then result = good jump to Arm Security System substate of Master Touchscreen Task else if command is system already armed result = already armed jump to Arm Security System substate of Master Touchscreen Task else if command is system not ready result = not ready jump to Arm Security System substate of Master Touchscreen Task else if command is password rejected result = password rejected jump to Arm Security System substate of Master Touchscreen Task else execute Neutral State without changing Contextual State end if

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**Detailed Description Paragraph Table - DETL (3):**

TABLE 3 _____ Simple Device Drivers are as follows: Analog input driver Audio and video driver Bath and spa Bus digital input driver Digital output driver Lighting mood driver without acknowledgment Random lighting driver Vacation mode driver Voice recognition Voice synthesis (low priority) The following complex device drivers are available: Lighting mood driver with acknowledgment Security Interface Driver Serial Digital Input Driver Voice Synthesis (high priority)

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**Detailed Description Paragraph Table - DETL (5):**

TABLE 5 _____ Support Environment Functions: _____ Display Cursor: Handles cursor movement and touchbox dynamics. Pullbyte: Pulls a byte of data from a specified Serial Input Queue. Colorchange: Changes any color within a specified rec- tangular area to any other color, according to the values passed it. Instimeevent: Inserts an event into the ISIS queue, according to the event type and event time passed it. Deltimeevent: Deletes an event from the ISIS queue, according to the event time passed it. Checktouch: Compares recognition templates and touch coordinates with the locations of the current touchboxes on the screen, and returns the number of any activated touchbox. Reloadsched: Reloads the daily schedule from a data file, screening out events that are not to occur on that day. Playafile: Speak a phrase. Playmemsequence: Speak a phrase followed by individual words, such as numbers. i.e. "The temp- erature is", "90", "5", "degrees". Loadscreen: Load a new menu screen and reset various graphics status variables. Loadslice: Load a portion of a screen. Loadvocab: Load a voice recognition vocabulary into a speech board. Initrecognition: Initialize voice recognition for a menu. Spchutil: A variety of routines designed to manage the speech boards in a cohesive, non-inter- fering manner. Commbyport: A general serial transmission routine. Avrsofterror: Error handler for code-detected

error conditions. Codeerror: Error handler for software run-time errors. Readana: Reads an analog voltage and/or temp- erature from an analog input. Readdigio: Reads the current values of all the interrupting digital inputs. Metrabyteread: Reads the current values of a group of passive digital inputs according to the value passed it. Metrabyteon: Turns on a digital output according to the values passed it. Metrabyteoff: Turns off a digital output according to the values passed it. Metrapulseon: Pulses a digital output on for the duration passed it. Metrapulseoff: Pulses a digital output off for the duration passed it.

**Detailed Description Paragraph Table - DETL (6):**

TABLE 6 *.pic: Full screen color graphics files in a format compatible with the hardware's color graphics controller board. These files are loaded by the HEART program into graphics memory to show a full-screen, high-resolution, color-graphics display on a monitor or touchscreen. *.fnt: Color graphics type fonts consisting of large characters and symbols to be dynamically displayed on the screen. *.icn: Icons and other graphics images designed to be displayed on the screen under program control. *.sct: Multi-word or complete phrase Speech Response data files in the proper format for the speech response hardware. *.spk: Single word or partial phrase Speech Response data files in a format for appending with other .SPK files to build variable speech phrases compatible with the TISPEECH board. *.voc: Vocabulary template data compatible with the TISPEECH board's recognition mode. When these files are loaded into the TISPEECH board by the HEART program, they define the active recognition vocabulary. *.img: software files containing routines to be loaded for the TISPEECH board. Depending on which routine is loaded, the TISPEECH board will perform voice recognition, speech response, or telephone functions.

**Claims Text - CLTX (5):**

audio communication interface means comprised of a voice recognition and speech system, through which the system and user communicate with each other, said voice recognition and speech system functioning together with said visual communication interface to provide cues to said user as to available commands, feedback of whether the current command has been accepted by the system and the results of performing said current command.

**Claims Text - CLTX (19):**

a plurality of additional communication interface means, including at least two of a keypad, serial data keypad, a voice recognition system, hand-held remote control, computer keyboard and telephone, said at least two additional communication interface means being

simultaneously connected with each other and said visual communication interface means to said programmed data processor such that said user may communicate commands to said system using any of said connected communication interfaces.

**Claims Text - CLTX (26):**

18. The system of claim 11, wherein the user may schedule the occurrence of user-determined events by the system by utilizing said voice recognition system.